

Ecology: The Biotic and Abiotic Environment

7-4 The student will demonstrate an understanding of how organisms interact with and respond to the biotic and abiotic components of their environments. (Earth Science, Life Science)

7-4.4 Explain the effects of soil quality on the characteristics of an ecosystem.

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In 1st grade (1-4.3), students recognized the composition of Earth including rocks, sand, soil, and water). In 3rd grade (3-3.1), students classified soils (including humus, clay, sand, and silt) on the basis of their properties. The properties of soil quality are new material for this grade.

It is essential for students to know that soil is one of the most valuable abiotic factors in an ecosystem because everything that lives on land depends directly or indirectly on soil.

- This will have an effect on the types of plants that can grow in an ecosystem, which directly impacts the types of other organisms that can survive there.
- Should soil quality change in any of its properties, the ecosystem (including life forms) will also change.

Soil quality is based on properties that can be observed such as soil profile, composition, texture, or particle size.

Soil profile

- Soils form in layers, or *horizons*, and all the layers make up the *soil profile*.
- A mature soil profile consists of three layers – topsoil, subsoil, and parent material above bedrock.
- Topsoil that is nutrient rich, containing a mixture of humus, clay, and minerals, is most suitable for plant growth.
- Most animals live in the topsoil horizon.

Composition

- Soil is a mixture of rock particles, minerals, decayed organic material, air, and water.
- The decayed organic matter in soil is *humus*.
- The sand, silt, and clay portion of soil comes from weathered bedrock material.
- The combination of these materials in soil determines the soil type and affects the types of plants that can grow in it or animals that can live in it.
- Factors that may affect soil type are the types of plants, climate, time, and slope of the land.

Texture

- Soil texture depends on the size of individual soil particles and is determined by the relative proportions of particle sizes that make up the soil.
- Texture names may include loam, sandy clay loam, silt loam, or clay depending upon the percent of sand, silt, and clay in the soil sample.
- The texture affects the amount of water that can be absorbed for use by plants and animals.

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Particle size

- Soil particles are classified by size ranging from coarse sand to very fine sand to silt, and finally to the smallest particle, clay.
- Soil particles that are larger than 2mm are called *gravel*.
- Particle size also affects the amount of water that can be absorbed and used by plants and animals.

Soil quality is also based on properties that can be measured, such as permeability and pH.

Permeability

- Soil particles have open spaces (*pores*) between them that let water flow through.
- How freely that water flows is the permeability of the soil.
- The closer the particles pack together because of particle size, the less permeable the soil is.
- Measuring permeability involves calculating the rate of drainage.

pH

- Soils can be basic or acidic and usually measure 4-10 on the pH scale.
- Indicators can be used to measure the pH of soils.
- Most plants grow best in soils with a pH of between 5 and 7.
- Regardless of the nutrients present in the soil, if the pH is not suitable those nutrients will be inaccessible to the organisms.
- Lime is a kind of fertilizer that alters pH and making the soil nutrients more accessible.

It is not essential for students to measure soil temperature or moisture content (although these are other factors that influence soil) or the factors that affect soil formation. The specific grain size for soil particle classification is not essential. Students do not need to identify or evaluate conservation methods to protect soils but a discussion on this topic may be appropriate to emphasize the importance of soil.

Assessment Guidelines:

The objective of this indicator is to *explain* the effects of soil quality on the characteristics of an ecosystem; therefore, the primary focus of assessment should be to construct a cause-and-effect model of properties of soil quality and how the ecosystem is enhanced by those qualities or how the ecosystem changes should a quality or several qualities change. However, appropriate assessments should also require students to *illustrate* a soil horizon using words, pictures or diagrams; *identify* the component parts of soil; *infer* the soil qualities that affect the amount of water soil can hold; *infer* what might happen to an ecosystem should a particular soil quality change; *classify* by sequencing soil particle sizes; *identify* a method for observing or measuring a soil quality; or *recognize* a soil quality based on its description.